

FAST

PROJECT HIGHLIGHTS

Announcement of Opportunity	
NASA Headquarters Office	Space Science & Applications
Enterprise	Space Science
Project	Fast Auroral Snapshot Explorer
Project Lead Center	GSFC
Management Approach	Augmented Hybrid
Mission Life (months)	24
Additional Data Analysis (months)	
Launch Date	21 Aug 1996

MISSION OBJECTIVES

FAST will investigate the plasma physics of auroral phenomena at extremely high time and spatial resolution. Data from the FAST instruments are expected to help identify the key physical processes that accelerate electrons into the earth's upper atmosphere and produce the aurora. To achieve these scientific goals, FAST will fly in a highly eccentric, near-polar orbit. The orbit will precess nominally one degree per day throughout the one year planned mission duration. Scientific investigations will operate in a campaign mode (about 60 days long) as apogee transitions through the northern auroral zone and in a less intense survey mode during the rest of the orbit.

FOREIGN PARTICIPATION

Ground Network Station

Santiago, Chile

Deep Space Network Stations

Canberra, Australia

Kiruna, Sweden

McMurdo, Antarctica

INSTRUMENT DESCRIPTIONS AND SCIENCE LEADERS

Data Point Number 751: The Magnetometer System instrument (MS) [protoflight] (FAST) includes a DC fluxgate magnetometer and two AC search coil induction magnetometers. The fluxgate magnetometer is a three-axis, boom-mounted instrument with highly stable lownoise ring core sensors. The search coil magnetometers, which are also boom-mounted, have three-axis sensor systems with laminated permalloy cores, windings and preamplifiers. The magnetic field information signals are further amplified in the electronics before analogto-digital conversion. The design is based on an OGO 5 instrument with recent developments implemented on military projects. C. W. Carlson (UCB) is the instrument PI.

Data Point Number 752: The Electric Field Plasma Experiment instrument (EFPE) (protoflight) (FAST) has ten sensors-two on each of four radial wire booms and one on each of two rigid axial booms. All except the four outermost sensors also operate as Langmuir probes. Design heritage is based on S3-3, ISEE 1, CRRES, Polar and Cluster. The EFPE instrument provides: vector measurement of electric fields; AC electric field waveform measurements; continuous monitoring of dominant frequency and amplitude of high-frequency waves; measurement of thermal plasma density and temperature; measurement of field density fluctuations anti time delays with different antennae; wavelength measurements using interferometric techniques; and multiple sensor separations. R. E. Ergun (University of California-Berkeley) is the instrument PI.

Data Point Number 753: The Electrostatic Analyzers instrument (ESA) [protoflight] (FAST) consists of sixteen ESAs configured in four stacks that will be used for both electron and ion measurements. The four stacks are placed around the spacecraft such that the entire package is provided a full 360-degree field-of-view. The ESAs can provide a 64-step energy sweep, covering approximately 3 eV to 30 Kev up to 16 times per second. Each ESA stack contains three Stepped ESA (SESA) analyzers that are used to make high time resolution electron measurements, plus a single ion or electron spectrometer (I EAS or EESA) that is used to make detailed distribution measurements. James P McFadden (University of California-Berkeley) is the instrument PI.

Data Point Number 754: The Time-Of-Flight Energy Angle Mass Spectrograph instrument (TEAMS) [protoflight] (FAST) is a high-sensitivity mass-resolving spectrometer with an instantaneous 360 x 8 degree field-of-view, designed to measure the full 3-dimensional distribution function of major ion species. The instrument selects incoming ions according to energy-per-charge by electrostatic deflection in a toroidal section analyzer with subsequent acceleration and time-of-flight (TOF) analysis. For each individual ion, the instrument measures energy-per-charge (electrostatic analyzer), mass-per-charge (TOF analyzer), incidence azimuth angle (given by spacecraft spin), and incidence polar angle. The instrument operates in various measurement modes (e.g., Survey Distribution, Hi Mass Distribution, Burst, Pole Channel and Monitor Rate). C. W. Carlson (University of California-Berkeley) is the instrument PI.

SPACECRAFT DESCRIPTION

The FAST spacecraft is mission unique (i.e., non-SAMPEX derived). The spacecraft is compact, lightweight, and extremely power efficient. The spacecraft has a body-mounted solar array, is spin-stabilized and rotates at 12 rpm with its spin axis normal to the orbit plane. Axial booms extend out from both the positive and negative spin axes. Four wire booms extend out radially around the belly band of the spacecraft. Two diametrically opposed magnetometer booms also extend radially from the spacecraft. The spacecraft subsystems include structural, mechanical, power, electrical mission unique electronics, attitude control, communications, antenna and thermal.

PAYLOAD DESCRIPTION

The FAST payload consists of four instruments - two field and two particle. To capture aurora) phenomena over small time (microseconds) and spatial scales, FAST will utilize high-speed data sampling, a large fast-loading ("burst") memory and smart on-board software to trigger on various key phenomena. With a 1-Gb solid-state memory and an 8-Mbs data acquisition rate that is significantly faster than previous satellites, FAST will produce high-resolution snapshots of aurora) arcs and other interesting aurora) events.

GROUND SYSTEM DESCRIPTION

FAST is a non-TDRSS mission. The FAST ground support elements are the Wallops Flight Facility (WFF) at Wallops Island, VA; a Wallops-provided transportable orbital tracking station (TOTS) at Poker Flat, Alaska, in the Northern Hemisphere; the Ground Network (GN) at Santiago, Chile, in the Southern Hemisphere; and the Deep Space Network (DSN) at Goldstone, CA, at Canberra, Australia, at Kiruna, Sweden, or at McMurdo, Antarctica, which will be used for contingency and backup support only. The FAST flight operations will be supported simultaneously with other SMEX missions (e.g., SAMPEX, SWAS) by the Missions Operations Center (MOC) at GSFC, using the transportable POCC (TPOCC) system. The Flight Dynamics Facility (FDF) at GSFC will provide orbit and attitude information and support to the University of California-Berkeley (UCB) for network scheduling, planning, and daily attitude control command inputs; and orbit information for science, verification and evaluation of the attitude control system. The Packet Processing System (PPS) at GSFC will receive downlinked data from each of the supporting ground stations. The PPS will perform data quality checks, level-zero processing and data distribution to the University of California Science Operations Center (UCSOC) at Berkeley, CA., and the Sensor Data Processing Facility (SDPF) at GSFC. The UCSOC will provide science data analysis and distribution to end users. The SDPF will provide data storage for 2 years.

CONTRACT AND SUBCONTRACT HISTORY

<u>Contractor/Subcontractor</u>	<u>Project Element</u>
University of California Berkeley	Instruments
GSFC In-House	Spacecraft
GSFC In-House	MSI&T
Adcole Corp.	Spinning Sun Sensor
Motorola	S-Band Transponder
TRW	Solar Array Panels

LAUNCH AND MISSION ORBIT DATA

Launch Vehicle/Upper Stage	Pegasus XL	Inclination (deg)	83
Launch Site	Western Test Range	Period (min)	133
Mission Orbit Type	Elliptical	Perigee (km)	4,159
		Apogee (km)	348